

DIPTEROUS PARASITOIDS FROM ADULTS OF MOTHS (LEPIDOPTERA)¹

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ABSTRACT: An adult moth, *Cucullia lucifuga* (Lepidoptera: Noctuidae), was parasitized by the maggot of *Sarcophaga aldrichi* (Diptera: Sarcophagidae). Circumstances suggest that the fly, which is a scavenger and a larval and pupal parasitoid of Lepidoptera, also attacks the adults of moths. This is the first report of a sarcophagid fly from the adult of a moth. The maggot of a phorid fly, *Megaselia rufipes*, is reported from the adult of another noctuid moth, *Amphipyra glabella*.

It is unusual to have the adult stage of a moth or butterfly parasitized. Adult lepidopterans with dipterous parasitoids of the families Tachinidae and Phoridae are known. Tachinid observations were presumed to be examples of larval or pupal parasitoids that carried over into the adult (Cockayne, 1911; DeVries, 1979; Smith, 1981). Flemyng (1918) reported an adult sphingid parasitized by a phorid fly, *Megaselia rufipes* (Meigen). Flemyng's original observation was too casual to ascertain whether the living moth or the carcass had been attacked. Borgmeier (1965) considers *M. rufipes* maggots to be polyphagous; Robinson (1971) documents a wide range of hosts from lepidopteran pupae to bat guano. Flemyng's report, however, may have some credence.

In July of 1997, I held a captive female *Amphipyra glabella* (Morrison) (Lepidoptera: Noctuidae), collected near Albany, New York, in a tightly sealed container for a week. Soon after the moth's death maggots could be observed. Two female flies emerged after ten days. These proved to be *M. rufipes*. Despite frequently having held moths for eggs, this was my first observation of phorid parasitoids killing a moth. Whole abdomens of moths are treated chemically when lepidopterists prepare specimens for dissection, and I have only twice encountered unidentified phorid maggot exoskeletons in the course of three thousand dissections.

The following represents the first report of a sarcophagid parasitoid of an adult lepidopteran.

Sarcophaga aldrichi Parker is an important internal parasitoid of the pupa of tent caterpillars. Hodson (1939) proved unequivocally that tent caterpillar larvae were not attacked, but that the pupae were. The fly has been reported as a parasitoid of the larva of the satin moth (Lejeune and Silver, 1961) and the gypsy moth (Hodson, 1939). Gypsy moth, satin moth, and tent caterpillars all make an exposed cocoon. *Sarcophaga aldrichi* is viviparous. A female lays its first instar maggot on the silk of the host's cocoon. The maggot finds its way through the silk to the pupa and feeds internally for 3 to 5 days. After this

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period the maggot may stay within the pupal cadaver for more than a month, eventually dropping to the ground to pupate (Hodson, 1939). *Sarcophaga aldrichi* also will breed in decaying organic material and carrion (Hodson, 1939) as do most *Sarcophaga* species (Sanjean, 1957).

On July 22, 1987, an adult female of *Cucullia lucifuga* [Denis and Schiffmüller] was captured nectaring at milkweed blossoms on the pine barrens near Albany, New York. The moth was held for oviposition in a plastic cup with a tight fitting lid. The moth died without ovipositing on July 24th. The following day the moth carcass had the legs, wings, and head detached. No internal organs remained. A third (ultimate) instar *Sarcophaga* (Diptera: Sarcophagidae) maggot was present. It had been an internal parasitoid of the moth. The maggot was offered additional fresh, decapitated, live moths and fresh cadavers of moths, but refused to feed. The maggot was kept in a moist container. It lived 51 days, until September, but died. Its carcass was preserved and identified as *Sarcophaga aldrichi*.

The caterpillar of *C. lucifuga* is a flower feeder. When fully grown, the caterpillar moves to the ground and enters the soil. It pupates in an underground cocoon. My pupation boxes have 15 centimeters of peat and *C. lucifuga* typically pupates at the bottom. The species is triple brooded in the north and the summer brood has a pupal stage that lasts for 10 days or more. Therefore, the sarcophagid loses its opportunity to parasitize *C. lucifuga* once the caterpillar enters the soil.

The fly is probably not a pupal parasitoid here, although it would have had the opportunity to parasitize the larva. Hodson (1939) did not observe larval parasitism by *S. aldrichi* in 100 field collected last-instar larvae of tent caterpillars. Sixty percent of the tent caterpillar pupae from Hodson's experimental site had been parasitized by *S. aldrichi*.

The sarcophagid maggot completes its development in 3 to 5 days (Hodson, 1939). *Sarcophaga aldrichi* is a large fly, larger than a house fly, and there is no chance of a parasitized host the size of *C. lucifuga* surviving. A large satyrine caterpillar has been reported as surviving despite having been parasitized by a tachinid maggot (DeVries, 1984); the caterpillar survived the exiting of the maggot and ultimately produced an adult. The maggot was not carried over to the butterfly's adult molt.

In the present case the adult may have been the stage initially parasitized. The reasoning for this is as follows: 1) I estimate the moth was 4-7 days of age at death (age determination based on my observations of many captive and bred lepidopterans); 2) maggot development time is 3-5 days; 3) the maggot was large enough to kill an organism the size of *C. lucifuga* at any stage; 4) the pupa was probably not parasitized because pupation takes place deep underground; 5) the larva was probably not parasitized because *S. aldrichi* seldom attacks larvae and the maggot development time of 3-5 days is too quick; 6)

the moth is active at early dusk, while there is still light, and both fly and moth can be found visiting milkweed blossoms simultaneously.

Given the relatively constant development time for the maggot, one would expect a small to mid-size imago to be killed within 3 to 5 days of attack. When I collected the moth, which I determined to be mated based on clasper marks, I estimated it to be 2-5 days of age. When the parasitoid emerged the moth would have been 4-7 days of age, sufficient time for a first stadium maggot to have entered the imago and completely matured.

The preserved maggot agrees well with the description and illustration of *S. aldrichi* given in Greene (1925). The maggot has anterior spiracles with multiple rows of lobes. This is a rare condition in *Sarcophaga*. The lack of spines around the posterior pocket and the prominent anal tubercles are all concordant with *S. aldrichi* morphology. The mouthparts of the preserved *S. aldrichi* maggot are illustrated (Fig. 1). Mouthparts were not illustrated in Greene's (1925) paper and prove to be valuable for species recognition. Subsequent captures of adult *Cucullia* in the last ten years have not rediscovered the parasitoid and it may prove to be a rare event.

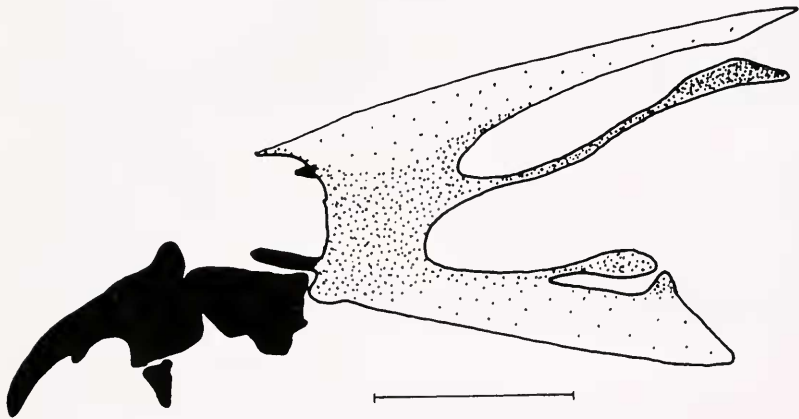


Fig. 1. *Sarcophaga aldrichi*. Cephalo-pharyngeal skeleton, showing mouthhooks and associated structures, third instar. Scale line = 0.25 mm.

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